

PULMONARY TUBERCULOSIS IN CHILDREN
WITH SPECIAL REFERENCE TO THE
DIAGNOSIS AND TREATMENT BY AUTO INOCULATION.

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by

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Pulmonary Tuberculosis in Children with
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Tuberculosis in children was not until recent years regarded as a frequent occurrence. At first the disease was looked upon as scrofula, until Laennec recognised the similarity between scrofula and consumption. Regarded as contagious in olden times, Villemin, in his communication in December 1865, on the cause of Tuberculosis and the inoculation of the same from man to rabbit, was the first to place the infective nature of Tuberculosis on a sound experimental basis and to show that the disease had its origin in an inoculable agent which was readily transmitted from man to some of the lower animals. Various experiments were shown by Klebs in 1877, and Aufricht in 1881 and Baumgarten in 1882 as to the infectivity of the disease, but it is to Koch, a medical officer in Wollstein, a small town in Polish Prussia, is due the great distinction of discovering, in 1882, the Tubercle Bacillus, and of establishing its invariable association with Tuberculosis.

From this time forward ideas began to widen with respect/

respect to the frequency of Tuberculous lesions in childhood, but it was not until the year 1905, when Harbitz published his pathological statistics for Christiana, that the prevalence of the disease in children was shewn to be so high. He showed that 42 per cent of all children who died had foci of Tuberculosis. Hamburger and Sluka's figures, for Vienna, show the presence of a focus in 40 per cent., and Comby's, for Paris, 38.5 per cent. In 1907 Wolff Eisner described a method of using the eye reaction to Tuberculin as a test for Tuberculosis, and this test, modified by Calmette and now generally known as the Ophthalmo Tuberculin Reaction, or Calmette test, was up till quite recently largely used as a means of diagnosing tuberculosis in children. This test was followed by Von Pirquet cutaneous test and Moro's inunction test, both of which were considered as compared with Calmette's method, to have the advantage of greater safety.

The result of the application of these tests to large groups of children show that a much greater proportion of children is infected with Tubercle than had hitherto been recognised by post mortem. By means of the Tuberculin Test Hamburger and Monte have claimed a Tuberculosis incidence of 90 per cent in school children, in Vienna, 14 years of age, and an incidence of/

of 70 per cent in children between the ages of 7 and 8, and an incidence of 20 per cent during the third year. From these statistics one is justified in making the assumption that Tuberculosis is ubiquitous, and that infection may be considered unavoidable.

In contra-distinction to the incidence rate of Tuberculosis in childhood, which starts at zero and rapidly rises to 90 per cent at the age of 14 years, the mortality rate among the new born is enormously high and rapidly sinks as the child grows older. According to Hamburger and Monte the mortality rate among children infected during the first two months of life is 100 per cent; at the end of the first year 50 per cent; at the end of the second year 20 per cent, and from the fourth year onwards probably remains at so low a figure as 2 per cent. This difference between Incidence and Mortality can be understood when it is considered that it is the Lymph glands form the main defence against the Tubercle Bacillus. These structures are well developed in children and mechanically arrest the disease, but in infancy such arrest is temporary and a spread to vital organs readily follows. In later years of childhood the glands, probably due to a mild infection from a dilute bovine source, having raised their tolerance, hold the infection and thus form clinically the primary focus from which the disease may not spread to other more vital organs. In children/

children there are thus two stages of the disease: a first stage in glands manifest or occult, and a second stage when the disease has over stepped these and appears in any other parts. The disease of Tuberculosis is one of the most important, and the commonest found in children. I have been very interested in the disease as found in children, and in my present thesis propose to give a general account of the question of the diagnosis and treatment of the Pulmonary form of the disease based on my experience of 100 cases I had under my care for a year at Queen Mary's Hospital, Carshalton, Surrey.

THE ETIOLOGY OF PULMONARY TUBERCULOSIS.

The essential cause of Pulmonary Tuberculosis as far as is known at present is the Tubercle Bacillus, and the sources of the Bacillus are man and animals infected with disease. Transmission must, therefore, be from man to man or from animal to man. It is then an infectious disease and to get Tuberculosis there must be infection with the Tubercle Bacillus and failure on the part of those infected to counteract the disease.

The belief that Phthisis was infectious has been held since the disease was first recognised and it has been proved by experiments to occur through the following channels:-

1./

1. Infection by Inoculation has been shown to occur by inoculating healthy animals with Tuberculous material. Lesions were produced in these animals which on examination were found to contain the Tubercle Bacillus.
2. Infection by Inhalation. Tuberculosis has been induced in animals by making them breathe in an atmosphere contaminated with the Tubercle Bacilli. The lungs in these animals were found on examination after a few weeks to have been Tuberculous.
3. Infection by Ingestion. Animals have been fed on Tuberculous material, and after a period examined post mortem, when it was found that the Mesenteric glands were enlarged and contained the Tubercle Bacillus.

HEREDITY AND PREDISPOSITION.

Two views are held with regard to heredity.

1. The direct transmission of the Tubercle Bacillus from the parent to the embryo.
2. The transmission to the offspring of a special weakness or predisposition on the part of those infected later to easily acquire the disease.

Direct transmission has been shown to occur from the sperm, ovum and placenta, it has rarely been found and would seem to be more of a direct embryotic infection than true heredity. It is not now generally held as/

as of great importance, and predisposition is now regarded as playing a more important part in the causation of the disease though its influence has been greatly modified of late years by the more exact knowledge of Phthisis.

Sources of Infection. As we have seen, the disease is transmitted from persons and animals infected with the disease. The chief possible means of infection from man to man are:-

1. Inhalation of dried Tuberculous expectoration.
2. Inhalation of particles of moist expectoration (Flugge).
3. From the discharge from Tuberculous abscesses, or Enteritis, or by urine from Tuberculous kidneys. These are of less importance and seldom have the opportunity of causing infection.
4. Infection from soiled hands.
5. Infection from saliva in kissing or from cups, spoons, etc.

Infection from animal to man.

1. From Tuberculous milk and other goods.
2. Infection from flies.

The Portals of Entry of the Tubercle Bacillus.

The question of how Tuberculosis is contracted is one on which much experimental work has been done, and on which so much diversity of opinion prevails, that it still remains unsettled. Koch, among others, maintains/

maintains that Phthisis is entirely due to the Tubercle Bacillus being drawn into the lung with inspired air, and has performed experiments to justify this conclusion. Von Behring, Calmette, on the other hand, maintain that Tuberculosis in all forms is contracted during infancy and that the Bacilli enter the body through the intestine; Calmette going so far as to deny the possibility of the Bacilli entering the lungs during inhalation.

The chief channels through which infection may occur are:-

1. Inhalation. 2. Ingestion. 3. Inoculation.
4. Other possible portals of entry are by special channels, e.g., The Urethra, Vagina and Uterus, conjunctival by transmission from the parent to the embryo, and by the mammary duct.

In the most recent experimental work on the portals of entry given by Corbett in the transactions of the Royal Society of Medicine it is shown that in order to get pulmonary Tuberculosis it is essential that a large number of Tubercle Bacilli should gain entrance to the body so that the important portals of entry are those three just named. This is also supported when the parts of the body most commonly attacked by Tubercle are considered - the lungs and the Lymphatic glands.

The lymphatic glands guarding absorption from the different/

different parts of the system are exposed to infection most frequently and may be grouped as follows:- (with the areas over which they guard) 1. Cervical group, guarding absorption from the scalp, ear, tonsils, teeth, and adenoid tissue of the naso-pharynx.

2. Bronchial group, guarding absorption from the larynx, trachea, bronchi and lungs.

3. Mesenteric group, guarding absorption from the intestinal tract.

In infection of the Cervical group of glands, one of the most common sources is that from the scalp, and is the most frequent cause of enlarged cervical glands seen in the out patient department of Hospitals. The scalp gets irritated from uncleanness in children and if they are exposed to infection by Tubercle it is possible the glands may become infected, the vitality of the gland being already lowered from septic absorption. Infection from the tonsil. It is held by some that the region of the tonsil is the most vulnerable to the Tubercle Bacillus. The tonsil becomes infected with the Bacillus through inhalation of Tuberculous dust or spray, or from the ingestion of Tuberculous food, the bacilli become lodged in the crypts of the tonsil and have been found here, though they have not produced any local lesion. Infection may then spread to the cervical glands. In absorption from the ear the Bacilli probably enter ^{by} the eustachian tubes/

tubes from the naso-pharynx and thus spread to the glands. Tubercle Bacilli have been found in the pulp of carious teeth and the frequency of large cervical glands in cases where there are carious teeth, suggests the possibility as a portal of entry.

ADENOID GROWTHS.

The part played by adenoids may not only be by acting as the part from which absorption of the Bacilli takes place, but may be of a more serious nature in the causation of Pulmonary Tuberculosis. The adenoid growths in the naso-pharynx by closing this channel inhibit the filtering properties of the Nares and cause mouth breathing. Thus the air entering the lungs is too dry, and not being warmed in the passage through the nares causes irritation to the bronchial tubes, thus rendering the mucous membrane more liable to penetration to any Tubercle Bacilli that may enter in the unfiltered air.

From the cervical glands thus infected the Bacilli may spread to the lungs:-

1. The Bacilli entering the lymph stream and get carried in the blood to the lungs.
2. Infection spreads to the bronchial glands and in this way extend to the lungs.
3. Infection spreads to the supra clavicular glands and thence to the apex of the lung.

INFECTION/

INFECTION THROUGH INHALATION may take place either by direct inhalation into the lung of the Tubercle Bacilli or from infected bronchial glands from which the Bacilli enter the lungs either by the blood or by the glands becoming caseous and perforating a bronchus. The possibility of Tubercle Bacilli entering the lungs by the air has been denied by some, who maintain that the infection occurs through the blood, but that air borne Bacilli can enter the lungs has been shown by experiments in which an easily recognised organism not commonly found in the lungs was used - *Bacillus Prodigiosus* suspended in water was sprayed into the air breathed by guinea-pigs, and the animals killed before there was sufficient time for absorption into the lymphatics. The Bacilli were found in the lungs in these animals. Similar results were found when Tubercle Bacilli were used. That Bacilli can enter the lungs has also been proved in feeding experiments with the *Bacillus Prodigiosus*. Corbett, out of 16 guinea-pigs fed in this way found the *Bacillus* in the lungs in twelve cases, and in similar experiments with Tubercle Bacilli found that by inoculating the emulsified organs of the animals thus fed into other guinea-pigs the Bacilli had reached the lung in three out of seven cases. These experiments show the possibility of direct infection to the lungs, which must be considered important, especially in those cases/

cases exposed to infection, and in which adenoid growths are present.

Infection through Bronchial glands. Here the lungs become infected secondarily from the bronchial glands which may have been infected.

1. From the mucous membrane of the Trachea, Larynx or Bronchi.
2. From the cervical glands.
3. From the mesenteric glands.

The Tubercle Bacillus can easily penetrate mucous membrane and thus enter the surrounding lymphatic glands, and in the Respiratory Tract where the mucous membrane has been injured by Catarrh or by spicules of dust it is more easily penetrated by Bacilli entering. The glands are thus exposed to infection, but if healthy are not likely to become diseased. In children however, the frequency with which these glands are inflamed from bronchitis, broncho-pneumonia, measles, whooping cough, and scarlet fever renders them less able to deal with any infection that may take place. From the infected bronchial glands the disease may spread to the Pleura and Lung, or it may reach the lung through the blood, and in children a not uncommon method is for the peri-bronchial glands to caseate and ulcerate through the wall of bronchus, and thus spread to the lungs. This I discovered post mortem had occurred in two of my cases, the bronchial glands were enlarged/

enlarged and mostly caseous, the right bronchus was perforated in both cases, the upper lobe of the lung showing an acute tuberculous process with cavitation throughout.

Infection from the cervical glands has already been considered. Infection from the mesenteric glands will now be considered under:-

INFECTION THROUGH INGESTION.

By this channel the Tubercle Bacilli gain entrance to the intestine by Tuberculous food or milk or from swallowed saliva, and penetrating the mucous membrane lining, the intestine, enter the lacteals and thus get carried to the mesenteric glands, and entering the lymph stream get carried to the lungs in the blood. The parts through which absorption may take place in this portal are the oesophagus, stomach and intestine. The teeth and tonsils though anatomically included in this system have already been considered, being also open to infection through inhalation.

Infection from the oesophagus is rare, though it has been suggested that the Tubercle Bacillus can perforate the lining mucous membrane and thus carry the infection to the bronchial glands.

Infection from the stomach. Tuberculous disease of the stomach is rare and there is no evidence that any infection occurs in this organ. The gastric juices are inhibitory to the growth of the Tubercle Bacillus/

Bacillus though it is not bactericidal. Tuberculosis of the stomach has been found secondary to malignant disease of the organ.

Infection from the Intestine has been shown experimentally by feeding animals on Tuberculous food, the bacillus being found in the chyle within a few hours. In children the mesenteric glands are frequently found to be Tuberculous and it has been suggested that the infection was caused by milk containing the Tubercle Bacillus. Infection may take place from saliva infected from dirty toys and dirty fingers.

In the various experiments on the portals of entry the number of Tubercle Bacilli found necessary to cause infection has been carefully worked out, and they show that a much larger number of Bacilli are necessary to cause infection through ingestion, than by inhalation; thus it has been found that so small a number as from 20 to 62 Bacilli given through inhalation infected guinea-pigs in which 20,000 given by feeding failed to cause infection. From the experimental evidence which is most extensive the balance seems to be more in favour of the Respiratory Tract being the most important portal of entry. The post mortem statistics on children also are in favour of this channel. Still, in a series of 269 cases, in which he found the probable source of infection in 216 as:-

Infection/

Infection entered through the lung in 138.

" " " " intestines in 63.

" " " " ear in 15.

Shennan (Edin.) gives the probable channel of infection in 331 cases:-

Infection through the Respiratory Tract in 67.07%

" " " Alimentary " " 28.1%.

MORBID ANATOMY.

According to the accepted modes of entrance of the Tubercle Bacillus the lung becomes infected from the bronchial glands, by the blood, or by direct inhalation. The changes produced in the lungs in Tuberculosis vary according to the mode of invasion, and to the number of Bacilli entering. The frequency of enlargement of the bronchial glands in children and the modes of infection from them to the lungs by spreading along the roots of the lung, by ulcerating through the wall of a bronchus, or by spreading to the pleura marks the great difference between the pulmonary tuberculosis found in children and that found in adults. In children the disease is found to be more widely spread and owing to the disease spreading from the bronchial glands along the root of the lung the lower lobe becomes diseased much more frequently than in adults. A further difference which frequently occurs is the perforation by a caseous gland of a bronchus. The caseous matter finds its way into one/

one or more lobes of the lung and there sets up an acute Tuberculous process with rapid cavitation. This condition I found very well shown in one of my cases, a child age 3 years, who was sent here to convalesce after an attack of bronchitis. On admission the child was found rather emaciated and weakly. There were no adventitious sounds in the lungs, though the breath sounds were feeble in the right upper lobe; the temperature was normal; the cervical glands were enlarged and also the bronchial glands were seen to be enlarged under X Ray examination. There was a dry harsh cough, and there was a positive reaction to the Von Pirquet test performed with human tuberculin. Shortly after admission the temperature became unsteady and the cough more severe. There were now crepitations heard at the right apex, which later became pronounced over the right lung. On post mortem examination the cervical, bronchial, and mesenteric glands were found enlarged, and the bronchial and mesenteric glands were caseating. Each group of glands contained the Tubercle Bacillus. There was general Tracheitis and at the lower end just above the beginning of the right bronchus there was a small ulcerated area containing pus. The opening was on the anterior wall and on passing in a probe a communication was found with an ulcerated bronchial gland. On tracing the right bronchus and bronchial tubes to their terminations very/

very extensive and acute tuberculous infiltration was found with cavitation at their termination in the lower part of the upper lobe, and at the apex, the lower lobe was greatly involved and the left lung was found studded with Tubercles.

TYPES OF THE DISEASE.

Pulmonary Tuberculosis may be primary or secondary and in either case may be acute or chronic.

The secondary form may result from:-

1. Simple broncho-pneumonia.
2. Tuberculous infection from other organs.
3. Acute miliary tuberculosis.
4. Bronchial glands.

Of the acute secondary forms the one most commonly found in children is that of the broncho-pneumonic type, known clinically as Acute Phthisis or galloping consumption.

It is the most frequent form of pulmonary tuberculosis found in children under seven years of age. The disease usually developes in the lower lobes and is due to the aspiration of the Tubercle Bacillus from a caseous bronchial gland which has perforated the Bronchus, in older children it may spread from caseous matter in an old cavity. The former is the more common and frequently follows an attack of measles or whooping cough. The post mortem appearance is similar to the condition just described though there may be evidence/

evidence of pleurisy, and the presence of a large quantity of fluid in the pleural cavity. Symptoms resemble those of an acute pneumonia following an attack of measles or whooping cough. The temperature is high and the prostration is marked, the condition gradually becomes worse and the temperature becomes hectic, there is profuse sweating probably due not only to the high temperature, but to the large amount of toxic absorption. The cough is severe and hacking at first, later it becomes more soft, though it is difficult to get a specimen of the sputum. Tubercle Bacilli will now probably be found either in the faeces or in the sputum if obtained. The condition becomes worse and death usually takes place within a very few weeks. If the perforation is small in the bronchus and the vitality of the child was good, the condition may not progress so rapidly and death may not occur for some months.

THE PHYSICAL SIGNS resemble those of an acute bronchitis, or if pleurisy is present friction sounds are heard until there is a collection of fluid in the chest. When the lung tissue becomes soft and extension takes place crackles are heard which later change to moist rales. At a later period there may be the physical signs indicating cavity formation, though this condition may not be reached and death supervening the condition and disease may not be recognised until post mortem evidence is obtained.

CHRONIC/

CHRONIC PULMONARY TUBERCULOSIS.

This is the usual form which is found in older children, it seldom occurs in children under seven years of age, but after this age is fairly common. The lesions found are the same as those found in adult life, and the part of lung mostly found diseased is at the apex about one inch from the upper margin. This form of disease is characterised by the formation of cavities which arise from the softening of a caseous nodule, on post mortem examination the cavities are found to contain broken down lung tissue, and they are lined by a distinct membrane in which small dilatations of the pulmonary artery are found. The pleura surrounding the cavity is thickened and the lung adjacent has usually become fibrous.

MODES OF ONSET.

These may be either with a bronchitis or more commonly in children the onset is gradual, the child does not take its food well and becomes anaemic, thin, and easily fatigued. Cough develops later and is noticed mostly in the mornings or when the child has been running about. An examination of the chest may now show signs of the disease at one or other apex.

SYMPTOMS. These are general and local.

General:- The fever is the most important initial symptom/

symptom of the disease, and is constant if the disease is active, the temperature is usually found to be above normal in the evening, generally about 6 p.m. In the early stages if the disease is active the temperature is continuous with slight rises in the evening, as the disease becomes more advanced and extends to another part of the lung the temperature becomes of the remittent type, and if secondary infection now takes place the type becomes hectic.

Sweating at night is a most common feature of the disease and though a common occurrence in Rachitic children should be regarded with suspicion in older children.

Loss of Weight. It is generally found that children in the early stages lose weight, though it often is found that the weight remains stationary in the early stages, and the loss in weight may not take place until the temperature becomes unsteady, at this stage the anaemic condition and general debility become more pronounced.

Local Symptoms:- Cough is commonly found and is present in the great majority of cases. It is an early symptom of the disease, and is produced from pressure of the bronchial glands, catarrh of the larynx, or may be from irritation of the nerve endings in the pleura or lungs. The cough from pressure by the bronchial glands is violently paroxysmal, and resembles whooping/

whooping-cough minus the whoop. In cases where the pleura is involved the cough is usually accompanied by pain in the chest. In the early stages the cough is dry, short, and is infrequent, later it becomes moist and troublesome, and a specimen may now be secured for microscopical examination.

Expectoration is present at some stage of the disease and in children is often difficult to obtain. At first it is mucoid and contains small jelly like masses containing alveolar epithelium, later the sputum becomes yellowish in colour, more dense, and may now be blood stained. It is an indication there is softening of the lung tissue. Microscopically, Tubercle Bacilli may now be found, and strands of fibrous tissue from the bronchi and alveoli. Blood corpuscles and small calcareous granules may at this stage be also present.

Haemoptysis is not common in children, and when found is usually small in amount, bright red in colour and mixed with mucous. It was present in only 19 of my cases and these cases showed cavity formation. In one case, of a child age 11 years, the quantity of blood and mucous was 18 ounces.

Dyspnoea. This is not ^{un}common in children and would seem to be due more to the anaemic and general debilitated condition of the child than to the destruction of lung tissue.

PHYSICAL/

PHYSICAL EXAMINATION.

Inspection. The shape of the chest varies with the stage of the disease or may be affected by previous disease, rickets or adenoids. In the early stage there may be limitation of the expansion of one side of the chest and the veins may be found dilated. Later in the disease the chest becomes flat, expansion becomes very limited, the clavicles stand out prominently and the general development of the chest limited. The skin may be clammy and the axillae moist, or it may be very dry and has an abundance of small fine hairs.

Palpation. This is the best method of detecting deficient movement either at the apices or bases. In the affected part of the lung the tactile vocal fremitus is increased, or if there has been pleurisy and thickening has taken place, it may be found diminished. The fremitus at the right apex is normally more accentuated and is accounted for by the epiterial bronchus to the right apex.

Percussion, an impaired resonance over, above, or below the clavicle is found in the early period of the disease. At first the note may be hyper-resonant, but as the disease advances the note becomes more dull, and finally when cavities have formed give the characteristic cracked-pot sound.

Auscultation. An early symptom is feeble breath sounds in the diseased parts, due to diminished air entry/

entry. The respiratory sound is jerky and "cog wheel" in rhythm. Expiration is prolonged and harsh. Crepitations may be heard at the end of inspiration, and are more clearly defined on taking a deep breath, or on coughing. As the disease advances the breathing becomes bronchial in type and the rales louder. The vocal resonance is increased. When the disease advances to cavity formation the breathing may be tubular or amphoric, the rales become more coarse; the vocal resonance may amount to bronchophony or whispering pectoriliquy may be present. Pleuritic friction may be heard over the lung in the earlier stages. In disease of the left apex diffuse heart sounds may be heard and a systolic murmur heard over the subclavian artery.

DIAGNOSIS OF PULMONARY TUBERCULOSIS.

The diagnosis of pulmonary Tuberculosis in its early stage - before any definite physical signs appear is a matter of great difficulty, and of much importance as it is in the early stage so marked benefits result from the proper treatment. In forming a diagnosis when the physical signs are indefinite and merely a matter of suspicion, every possible evidence must be obtained and a thorough routine examination made, even then it may be impossible to come to a definite diagnosis, and in these cases repeated examinations and/

and close observation of the child may be necessary.

The routine which I followed in my wards may be outlined as follows:-

The history of the case.

General symptoms.

Local symptoms.

Special examinations - X Rays, Laboratory investigation and Tuberculin reaction.

The History.

Though not much importance is not now attached to the heredity of Tuberculosis, a history of tuberculosis in the family is of very great importance, especially if the child has been exposed to the risk of infection from this source.

In the 100 cases under my care the following history was obtained giving the possible sources of infection:-

Both parents tuberculous. . . .	8
Father only tuberculous	36
Mother " "	21
Brothers & Sisters only tuberculous .	5
Distant relatives tuberculous . .	11
No known source of infection. . .	19

The history of the previous illnesses from which the child has suffered, e.g., enlarged tonsils and adenoids, measles, whooping-cough, and possibly scarlet fever. These by lowering the vitality of the/

the bronchial mucous membrane and causing an inflammatory condition of the lymphatic glands act as predisposing causes to infection with the Tubercle Bacillus. A history of haemoptysis and pleurisy is seldom found in children at an early period of the disease. The general health of the child will usually be found not good. The appetite has been poor and there is the common history that the child complains of "feeling tired," and will not play about with the other children - this fact is found in nearly every case.

GENERAL SYMPTOMS.

Night Sweats. This is one of the most common symptoms of the disease. At first it may only be slight, and is usually confined to the axillae, later it becomes more severe and beads of sweat are noticed on the face during sleep. It is also a symptom found in rickets, but when present should always be an indication for careful observation of the temperature. This may show a rise of one or two degrees in the evening, though not uncommonly sweating is present without any febrile condition.

Loss of Weight is usually found and varies with the extent to which the disease has developed. In the beginning the loss may not be great, but it is noticed that the weight remains stationary. It is a most valuable guide as to the progress of the disease.

Cough/

Cough is the most significant symptom and may be the first to attract attention, it may only be slight at first and occur only after some form of exertion or it may be present first thing in the morning. The character of the cough should be carefully noted and its cause ascertained if possible. If due to pressure from enlarged bronchial glands, it is paroxysmal and violent; there is no expectoration.

Expectoration does not occur in the early stages of the disease and when present indicates a probable breaking down of the lung tissue. In children it is difficult to collect a specimen for examination, but it can easily be obtained by placing a swab at the back of the pharynx when a sufficiency will be obtained for microscopical examination. When present it should be carefully and repeatedly examined by the ordinary methods and if negative by the more refined method of Uhlenhuth and Xylander, if no sputum can be obtained the faeces should be examined by this method owing to the frequency with which children swallow the expectoration.

Fever is the most important symptom and it is impossible to form a trustworthy opinion without knowing what the patient's daily temperature had been. A single observation may be misleading, and in all doubtful cases a careful record of the temperature should be kept for some days, under close observation. A record should/

should be obtained under different conditions of rest and exercise. The child should be kept in bed for 48 hours and the temperature taken two hourly, then allow some exercise in the form of walking or drill, and take the temperature directly afterwards, and also after from half to one hour, during which time the child should be at rest, lying down. If directly after rest the temperature shows a rise it indicates a possible toxæmia from auto-inoculation, and if there is other evidence of Tuberculosis the toxic substance producing this rise is probably the product of Tubercle Bacilli. In taking the temperature it is sufficient to place the Thermometer in the mouth under the tongue, but it should not be taken out for at least ten minutes, this will give time for the mouth to attain the temperature of the body, but it is important that the lips be kept closed, and that no food or liquids of any sort should be taken for some time previously. The temperature after exercise in a tuberculous patient is usually more marked and persistent than the rise produced in a healthy child, and the condition of the patient can roughly be gauged by the length of time during which the temperature remains raised in consequence of a certain amount of exercise.

Pulse. In the non-febrile cases no alteration may be found in the pulse rate, but in those cases where fever is present the pulse is generally accelerated in proportion to the extent of the fever and the exhaustion/

exhaustion of the patient. In the morning the pulse is slower and increases in frequency as the day goes on and as the temperature rises.

Pain, if present, is usually due to pleurisy and is referred to the lower region of the chest. It may sometimes be referred to the apex of the lung in front, or to the scapular region, and in some cases I have had the pain has been complained of in the shoulder.

Other general symptoms are:- Loss of appetite and fatigue after exercise. These cases are usually pale and anaemic in appearance, and found to be poorly nourished.

LOCAL SYMPTOMS.

In making the examination every possible source by which the Tubercle Bacillus might enter should be examined; the condition of the teeth and tonsils, and the naso-pharynx should be examined. I found in my cases that every one had carious teeth, and in 19 the tonsils were enlarged and required removal. The presence of adenoids was found in 32 instances. The condition of the lymphatic glands should next be investigated and if enlarged the possible cause. In most cases the cervical glands are the ones most commonly enlarged, probably due to absorption from carious teeth. The general condition of the child will be found to vary. The skin may be unusually dry and scaly, or it may be moist. It is often found that the limbs are dry and the axillae are moist.

PHYSICAL/

PHYSICAL SIGNS.

In the early stages of the disease the physical signs may be quite indefinite, and to wait the development of these before forming a diagnosis may leave the patient beyond the stage in which early treatment would have been of great benefit. Definite disease may be present in the lung without any definite physical signs and it is at this stage the disease should if possible be diagnosed:- before there is any breaking down of the lung tissue and when the stage is that known as closed Tuberculosis.

The early physical signs which should be sufficient to indicate the proper methods of treatment are:-

Slight loss of resonance at one or other apex.

Deficient movement of the chest on inspiration.

Slight increase of the vocal resonance, though this may be mistaken if it is not remembered that the vocal resonance is louder at the right apex.

On auscultation, two most important physical signs should be investigated. These are Cog-wheel breathing, with diminished air entry into this part of the lung, and the presence of crepitations. These are more commonly found over the posterior surface of the upper apices, in the supra spinous fossae. If present it should be noted at which time of the respiratory movement they occur. They may be due to catarrh of the/

the bronchi, or to emphysema, and it is important to make the patient cough and note the effect. By doing this crepitations may now be heard which were not found during respiration. The persistence of crepitations on coughing, or the presence of those known as post tussic crepitations are most important, and the most valuable physical sign we have of an early tuberculous focus. These physical signs though indefinite when taken in conjunction with other symptoms such as cough, fatigue, and slight fever may form sufficient ground to make a probable diagnosis.

SPECIAL EXAMINATIONS.

Whenever expectoration is present, and there is any reason to suspect the presence of Tuberculosis, it should be examined for the presence of Tubercle Bacilli. If positive the diagnosis of a definite lesion in the lung is conclusive, and if negative repeated examinations of the early/^{morning} expectoration should be made. In children owing to the difficulty often of obtaining a specimen of the sputum the faeces should be examined by the anti-formin method. It is also advisable to examine the sputum by this method in those cases in which the ordinary method has given negative results. The following is the method which I have used in my examinations:-

Requisites/

Requisites: Antiformin, which is a solution composed of equal quantities of Liq. Sod. Hydratis 15%, and Liq. Sod. Chlorinatae.

Acetone, distilled water.

Methylated ether.

Test tube with rubber cork.

A quantity of sputum is taken in tube and shaken for five minutes with antiformin, using about half the amount of antiformin if the sputum is thin, and an equal amount if it is viscid, then dilute with ten times the volume with distilled water of the antiformin used and shake again for five minutes. Finally add equal quantities of acetone, and methylated ether equal in volume to that of the water used, shake well again and allow to stand, when there will be found three layers, the middle layer is a white ring and in this the Tubercle Bacilli, if present, are concentrated. Draw this layer off with a pipette, and make a film in the usual way. It is advisable to immerse the film in a 5% sulphuric acid for a few seconds before staining.

X RAY EXAMINATION.

When possible to obtain an examination of the chest with the X Rays a most valuable diagnostic method is secured. In children it is especially valuable owing to the ease with which the condition of the/

the lung is seen through the thin chest wall. The chief signs indicated in this way are:- The enlargement of the bronchial glands; the diminished movement of the diaphragm on the side in which disease is present; the failure on the part of the lung diseased to light up on inspiration, and the less translucent appearance of this part on expiration to the surrounding lung tissue.

TUBERCULIN REACTION.

For the specific diagnosis of Tuberculosis four methods of testing with Tuberculin are in use.

1. The Cutaneous.
2. The Percutaneous.
3. The Subcutaneous.
4. The Conjunctival.

The specific reaction to Tuberculin is an acquired peculiarity. It is not found present at birth and increases with age in proportion to the known frequency of Tuberculosis. A positive reaction implies infection of the body with Tubercle Bacilli at some time or other, but does not indicate whether the infection is latent or active.

The Cutaneous Test. The theory and practical application of Tuberculin vaccination was introduced by Von Pirquet. His observations with ordinary lymph vaccine led him to the conclusion that reaction within/

within 24 hours only occurred in a previously vaccinated subject and that it was brought about by the union of Toxic Vaccine and reaction products which he termed antibodies and that the presence of these antibodies as shown by the reaction to the vaccine is proof of previous infection. An analogous reaction occurs when a Tuberculous subject is inoculated with Tuberculin and the characteristic local reaction is due to the rapid local formation of antibodies, as the result of the Tuberculin stimulus. In the method used by Von Pirquet, old Tuberculin in two strengths, one undiluted and the other a 25% solution with $\frac{1}{2}\%$ phenol for preservation is used.

With the undiluted solution one application is usually sufficient whereas with the diluted several inoculations may be necessary before feeling justified in accepting the conclusion. In children the diluted Tuberculin is sufficient, as cases which are negative usually give the same result when the stronger solution is used. A negative result takes place even if Tuberculosis is present, if the child is suffering from measles, and may be negative in cases in which the disease is advanced, or in cases in which there is mixed infection; it may also be negative in cases of Tuberculous meningitis, and in the final stages of miliary Tuberculosis. The absence of reaction in these/

these cases is due to a failure of the physiological response to the stimulant Tuberculin. There is no general reaction, but only local symptoms follow the application of the cutaneous method. Reaction manifests itself in from 12 to 24 hours. The site of inoculation most suitable is the skin of the forearm, which should be rubbed with ether, Von Pirquet recommends a circular scarification on which he applies Tuberculin, having also one scarification used as a control. The method which I found more satisfactory was to have a linear scarification about one inch long, in this way a reaction which may not be visible can be more readily palpated and any local thickening detected.

In making the scarification it is advisable that it should only be superficial, it is quite sufficient for the test, and if deep scarification be used a positive reaction may be accompanied by enlargement and tenderness of the regional lymphatic glands. It also minimises the delicacy of the test. The positive cutaneous reaction is a specific anatomical tuberculous lesion and it has been shown by Daels, who in microscopical sections of the papules found central giant cells of the typical Langhous form with epitheloid and round cells at the periphery. From this it might be suggested that there is the possibility of general infection, but so far no evidence is forthcoming in support of it.

PROGNOSTIC/

PROGNOSTIC AND LOCALISING VALUE.

A positive reaction to the Tuberculin cutaneous inoculation gives no indication of the site or activity of the Tuberculous focus, neither does it prove the disease the person is suffering from is Tuberculous.. It simply indicates that at some time the subject has come in hostile contact with the Tubercle Bacillus, a negative result indicates absence of Tuberculosis except in advanced cases, in miliary Tuberculosis, Tuberculous meningitis in cases which have been artificially immunised, or in cases where there is measles or scarlet fever.

Von Pirquet's method is an extremely valuable and reliable means of detecting latent or active Tuberculosis as shown by the fact that 97-98% of known cases of Tuberculosis both in adults and children react, and if we exclude those in the advanced stages etc., its action may be said to be constant. An account of its harmlessness and the simplicity of application; its prophylactic value, more especially in investigation and hygienic treatment of school children cannot be overestimated.

THE PERCUTANEOUS TEST OF MORO.

Moro, whose method followed that of Von Pirquet rubbed into the skin of the epigastrium equal parts of old Tuberculin and anhydrous lanoline. Its diagnostic value/

value is considerably inferior to the cutaneous method, for not only is the tuberculin diluted, but the intact skin, the permeability of whose Epithelium is very variable, is used as the medium of absorption.

THE CONJUNCTIVAL TUBERCULIN TEST.

Although this method is usually associated with the name of Calmette, and called the ophthalmo reaction, Wolff Eisner, at an earlier period showed the possibility of a local conjunctival reaction in cases of Tuberculous disease and designated the reaction The Conjunctival Reaction. The reaction is still considered by Wolff Eisner of use in the diagnosis of active Tuberculosis provided that the test is not repeated; its value in diagnosis is, however, greatly disputed by other authorities, since it is impossible to be sure of avoiding harmful results it seems inadvisable to risk harmful results to such an important organ as the eye. A further disadvantage is that occasionally after its use, treatment by Tuberculin has to be suspended on account of conjunctival congestion and inflammation following each injection.

THE SUBCUTANEOUS TUBERCULIN TEST.

This is the oldest method in use, and is performed with Koch's old Tuberculin from cultures of human Tubercle Bacilli. Another Tuberculin prepared by an analogous process from Bovine Tubercle Bacilli is also used/

used, but as it is less certain in its action and the reaction occurs later, it is not frequently employed. Two dilutions are used, 1-100 and 1-1000 with the usual .5% phenol for preservation purposes. The great advantage of this test is accuracy of dosage, and when it is remembered that Tuberculin is the most powerful therapeutic agent we possess, the importance of this is apparent. The initial dose for children should be one-tenth of a milligramme, and if negative half a milligramme if necessary; this may be repeated and finally if negative a dose of three milligrammes. It is necessary to increase the doses suddenly for the production of a reaction, otherwise a Tuberculin tolerance occurs.

In using the subcutaneous method three reactions may be present.

1. Local at sight of injection.
2. General, rise of temperature, headache, etc.
3. Focal reaction at sight of Tuberculous focus.

Before using this test an accurate record of the temperature for some days must be obtained and also of the physical signs - if any - present, and the general condition of the patient.

The local reaction manifests itself in an inflammation and thickening of the tissues at the sight of injection, and also in the so called "needle tract" reaction.

The/

The general reaction is shown by a rise of temperature above the highest previously recorded, Headache, loss of appetite, and general malaise.

The Focal is the most important in forming a diagnosis, and shows itself principally in increased evidence of disease in the Tuberculous focus. The accentuation of physical signs is now regarded as of almost equal testimony of the presence of the disease as the finding of the Tubercle Bacillus. This action of the subcutaneous test is one of the great advantages of the method as compared with the other diagnostic tests.

The augmented physical signs and symptoms vary, of course, with the tissue involved in the morbid process. Glands become tender and swollen, bones and joints indicate its presence by pain and swelling. In the respiratory organs crepitations may be heard now. Expectoration may increase, pain in the chest, and in some cases there may be some haemoptysis.

CONTRA INDICATIONS TO THE USE OF TUBERCULIN SUBCUTANEOUSLY FOR DIAGNOSTIC PURPOSES.

Where the ordinary methods are sufficient to establish a diagnosis Tuberculin subcutaneously is superfluous and may under certain circumstances be attended with positive harm.

It should not be used in febrile cases or in cases where/

where the temperature in the axilla is much above normal, on account of the difficulty of correctly estimating the amount of fever due to the reaction. It is contra indicated in cases of recent haemoptysis, in advanced and serious heart disease, more especially those cases in which the myocardium is affected, in nervous patients, in disease of the kidneys. It is advisable to withhold its use in cases of intestinal ulceration and in the convalescence from severe diseases such as typhoid fever, pneumonia, etc., for fear of aggravating or disseminating any Tuberculous disease that may be present. Of the various tests from Tuberculin reactions in children Von Pirquet's is most trustworthy and harmless, and may be taken as a serviceable criterion for diagnosis in children under seven years of age, as at this time of life any Tuberculosis present is, in the great majority of cases, active, and thus of clinical significance. With increasing age there is an increasing amount of rudimentary Tuberculosis, which has become inactive and healed. This latter is of no clinical significance, but nevertheless produces a positive cutaneous reaction. In cases, however, in which other early symptoms of the disease are present and in suspicious cases a positive Von Pirquet even in children up to 12 or 14 years of age should be an indication to keep the child under close observation and under the best hygienic/

hygienic-dietetic circumstances.

The other special methods of diagnosis such as agglutination, complement-fixation, the opsonic estimations and the activation colra-toxin, are complicated and difficult to carry out and for so far having proved in general of little practical value, do not materially add to the possibility of forming an early diagnosis.

DIAGNOSIS OF ENLARGED BRONCHIAL GLANDS.

In children the bronchial glands may often be found to be enlarged, probably due to Tuberculous disease, before any physical signs are found in the lungs, and when it is remembered how the disease may spread from these glands to the lungs

1. By perforating a bronchus.
2. By invading the pleura.
3. By entering the lung tissue from the blood.

The importance of diagnosing this condition and placing the child under the best possible hygienic-dietetic conditions cannot be exaggerated. The general symptoms of enlarged bronchial glands. The most important of these is the character of the cough, this is loud, dry, harsh, and spasmodic. It closely resembles that of whooping cough but there is no whoop.

There is not usually any fever - unless the glands are beginning to break down, and toxins are absorbed.

At/

At this stage the lung and pleura is generally involved and other physical sounds may be heard.

The general condition of the child is not as it should be, and shortness of breath may be present on exertion.

The local signs.

1. Dilatation of the veins of the chest is an indication of pressure in the mediastinum, which in children is probably due to enlargement of the bronchial glands.
2. Deficient movement of the chest at either apex or base, from pressure of the glands on the bronchus.
3. Diffuse pulsation of the heart.

ON PERCUSSION.

1. An impaired resonance especially to the right of the sternum, at the level of the second intercostal space in front, or in the inter-scapular region at the level of the division of the trachea, is an important sign of enlarged bronchial glands.

ON AUSCULTATION.

1. Defective air entry into one lobe is probably due to pressure by enlarged glands on the bronchus.
2. The presence of a bruit at the inner end of the clavicle on forcible extension of the head is according/

according to Eustace Smith another sign of enlargement of bronchial glands.

3. In enlargement of the bronchial glands the vocal resonance is of a tracheal character below the usual level of the 7th cervical spine (D'Espine).
4. Inspiratory stridor heard universally over both lungs due to pressure on the trachea (Still).

X RAYS EXAMINATION.

On examining the chest with the X Rays important manifestations are seen.

1. A definite shadow in the mediastinum, which may be traced along one or both bronchi.
2. Deficient movement of the diaphragm due to diminished air entry into the lung of one side from pressure by enlarged glands.
3. Where there is diminished air entry into one lobe it will be seen that on inspiration this part of the lung is less translucent on deep inspiration than the surrounding parts.

TREATMENT OF PULMONARY TUBERCULOSIS IN CHILDREN.

The treatment of Tuberculous conditions in childhood must be considered from two points of view.

1. From the Prophylactic.
2. From the Therapeutic.

Prophylactic Treatment.

From the statistics already given of the frequency of/

of Tuberculosis in children, it may be concluded that the great majority of persons suffering from the disease have received the infection during childhood. The importance then of thoroughly dealing with this disease from every point of view in childhood cannot be too strongly urged, and every means available made use of in the prevention of the disease. Most children seem peculiarly susceptible to infection with the Tubercle Bacillus, and we must endeavour as far as possible to protect against infection, and to keep the condition of the system in such a condition of health that should infection occur there will be an adequate resistance to prevent the disease becoming manifest.

During the first two years of life preventative measures are far more important than lines of treatment designed to mitigate or cure established disease, for as we know infection at this age is almost tantamount with a sentence of death. The most essential step in these circumstances is to remove the child from an environment of open infection. If the mother is the subject of Phthisis and has Tubercle Bacilli in her sputum, it is almost inevitable that the child will become infected, and in cases where there are other open sources of infection may be taken as living in a specially dangerous zone. If young children are artificially fed special precaution should also be used. It is now recognised that milk frequently conveys/

conveys the germ of Tuberculosis, and that the cause of the disease in young children is the drinking of infected milk. To meet this danger two precautions are necessary, first, all milk should be boiled, especially when it forms the staple diet, as in the case of young children. The simplest way to sterilize milk is to put it in a jar and place the jar in a can of water, the water is then boiled for fifteen minutes. Secondly, milk should never be allowed to remain uncovered as it very readily becomes contaminated by flies and dust.

This precaution should never be omitted when a member of the family is suffering from consumption in its advanced and incurable form.

Although no prophylactic measure can compare in importance with the removal from sources of open infection, there are other preventative expedients useful in all cases, but particularly to be studied in those cases which without being exposed to known sources of open infection are specially liable to accidental contamination. As we have seen the parts of the body most liable to infection with the Tubercle Bacillus are the lymphatic glands. Damage of any kind to the lymphatic system as affording seats of lessened resistance, enhances the chance of a serious Tuberculous invasion. Thus, all factors which predispose to catarrhs, predispose also to Tuberculosis. The sources of irritation and absorption to the cervical glands/

glands are the teeth, the tonsils, the adenoid tissue of the naso-pharynx, the scalp, and the ear. All these tissues must, therefore, be kept healthy, and on the appearance of any glandular enlargement must be carefully examined and treated if necessary.

The larynx, trachea, bronchi and pulmonary tissues are the sites of entrance of Tubercle Bacilli to the glands at the root of the lungs and around the trachea. Neglected colds, chronic bronchitis and pneumonia, may allow of penetration of Bacilli which pass to the glands and develop there. They may continue to grow long after the pulmonary or bronchial trouble has passed off entirely. Hence comes the importance of treating the respiratory troubles thoroughly so as to maintain the respiratory passages in a healthy condition and thus prevent the entrance of the Tubercle Bacilli. Similarly the development of Tuberculous mesenteric glands is to be traced to a weakened condition of the mucous membrane of the intestine from catarrh etc. If it were possible to maintain the alimentary and respiratory passages in a healthy condition we should have made great strides in the prevention of Tuberculosis in early life, even amongst that class of the population where the general surroundings are unsatisfactory. Other factors which predispose to catarrhs are, badly ventilated rooms, dust, confinement in doors, and improper/

improper clothing, and feeding. All these are measures which can be easily carried out by intelligent parents or guardians of children. They are most important measures in the prevention of the colds and chills to which infants are subject, and which so frequently precede manifestations of Tuberculous infection.

Another prophylactic measure to which much importance is attached by some authorities, is a varied and liberal proteid diet, either in breast fed or bottle fed children. In addition to the ordinary milk diet small supplementary feedings of raw meat juice, yolk of egg or plasmon, and other easily digested forms of albuminous food can in either case be given with advantage even in the case of quite young infants.

After the second year of life when protection from infection ceases to be so urgent a necessity, our energies should be directed towards supporting the strength during those special periods when Tuberculous disease is known to run a serious course, e.g. during the convalescent stages of measles, whooping cough, chicken pox and to some extent scarlet fever. At such times removal to a more bracing air at the sea or in the country is an important measure as a prophylactic.

Since it has been made possible to deal more thoroughly with Tuberculosis under the National Health Insurance Act 1911, it is to be hoped that special attention/

attention will be paid to children and that more provision will be made for their Institutional treatment than is done at present. This for so far is woefully inadequate, and it seems a pity that so much money is spent on providing Sanatorium benefits on adults, and so little for children. Surely if the Anti Tuberculosis Campaign is to be a success the children, in whom the disease can be detected early should be the ones to have special provision made for their treatment, and the interim report of the Advisory Departmental Committee ^{on Tuberculosis} clearly indicates this truth and declares that the more the resistant power of children is increased, the lighter will be the burden of Tuberculous disease in adults in the next generation. It is also pointed out that childhood affords an excellent opportunity for detecting and dealing with Tuberculosis, and the factors which tend to weaken the defensive powers of children can be brought under control easily and at an early stage.

Even though the accomodation at present for the treatment of Pulmonary Tuberculosis in Institutions is inadequate, much good will result from the present campaign, not only from the Therapeutic treatment, but from the improved supervision and education on general hygienic conditions.

The working of the scheme at present is under the Public Health Authorities; the Medical Officer of Health/

Health acting as chief administrator, with a Tuberculosis Officer who is entirely responsible for the clinical side of the work, and a staff including nurses, health visitors, and care committees. It is thus possible that every case of Tuberculosis can, in Urban areas, receive suitable treatment at the dispensary, or at his own home. Most authorities are making provision for treatment at an Institution, having a Sanatorium for treatment of suitable cases, and hospitals for the isolation and care of advanced cases and for the observation of doubtful cases. Of these the dispensary is the most important unit as it is from here all supervision and treatment of the majority of cases will take place, most of the cases returning from the Sanatorium requiring supervision, and in some cases a further course of treatment. The dispensary is open at various times of the day and evenings, both for treatment and for examination of new cases and contacts. Undoubtedly much benefit will be seen after some time. The public are being educated to the value of fresh air, and precaution against infection. The examination of "contacts" reveals many early cases in which appropriate treatment brings about a cure or arrest in the disease which, if untreated would sooner or later develop into a marked and open case and thus keep up the source of infection. The housing conditions will be improved, and mothers educated/

educated on the proper care of the treatment of children. Under fed and unclean children will receive the /attention of the care committees and suitable food and clothing provided. The Sanitary Authorities will look to the disinfection of the houses in which infection has been present and see that this is carried out in those cases in which death has occurred, or in which an infective person has left the house.

In scattered rural areas the work of the Dispensary is minimised, and it is impossible for many cases to receive treatment from the Dispensary owing to difficulty of access. In rural areas Institutional treatment is more urgently required, and it is in my experience more essential to have cases removed to an Institution from a rural area than from a town. In cases which develop Pulmonary Tuberculosis in a rural area, the disease progresses more rapidly, and it is comparatively seldom one finds a patient suffering from the disease who is able to attend his work while having treatment/ ^{by tuberculin} at a Dispensary. In children the disease progresses even more rapidly and in the majority of cases becomes febrile. Since taking up this work in rural areas, I have made inquiries as to the possible cause of this, and I find that the resistance of country children to Tuberculosis is lowered from many reasons.

1. The food of the artisan country child is totally inadequate to nourish the growing body. In most cases/

cases bread and tea is taken at each of the four meals per day, with the addition of bacon at the mid-day meal. Butchers meat is seldom used, and never more than once a week.

2. The housing conditions are worse in some cases than in towns. The rooms are small, and the windows are constantly kept closed, and often the chimneys when present are packed.
3. The clothing is inadequate for the varying conditions of cold and wet weather.
4. All these conditions together lower the vitality of the child to such a degree that there is no resistance to any infection with Tubercle Bacillus.
5. A possible cause is that the child has not had the same repeated small doses of infection and thus there is a hyper sensitiveness to an infection when this occurs.
6. Though Heredity is not now considered as of great importance, undoubtedly the phthisical diathesis is especially marked in country children. In every child I have found with definite evidence of Tuberculosis, there has been a definite family history of Tuberculosis.

Institutional treatment is then in these cases most necessary so that they can at the earliest manifestation of the disease be put under the best possible Hygienic Dietetic conditions.

Much improvement is yet necessary in the accomodation provided/

provided in the public elementary schools, and in the thorough ventilation and proper heating of these. In the prophylactic measures against the disease the campaign must commence in the homes of the people and with the people themselves. To deal with the disease from the Therapeutic standpoint is useless, and hopes based on any single method are foredoomed to disappointment.

THERAPEUTIC TREATMENT OF PULMONARY TUBERCULOSIS.

The essentials for the treatment of Pulmonary Tuberculosis are Fresh Air, good food and freedom from any cause calculated to lower the general health. To these essentials should be added special treatment in suitable cases. These are from Auto-inoculation from graduated labour, or exercises and from Tuberculin.

In Sanatorium treatment the essentials are a sine qua non, and the comparative values of treatment by Tuberculin and by rest and exercise is still a matter more or less experimental. A detailed account of the treatment by either of these methods is not the purpose of this paper, and I will outline the methods I used and give conclusions I formed in the treatment of my cases from graduated exercises and from Tuberculin and graduated exercises combined.

Treatment by means of Auto-inoculation by graduated rest and exercise depends on the production of toxin
by/

by the patient himself. Rest is the control which is devised to check excessive inoculation when the response is weak, and exercise the artificial stimulant of auto-inoculation when the response is likely to be adequate.

Treatment by this means is not of universal application. Two essential conditions are required before a patient can have this form of treatment.

1. The patient must be a febrile and free from all constitutional symptoms.
2. The patient must be able to remain up all day and to do a certain amount of walking without any rise of temperature

The aim in this form of treatment is to get the patient into a sufficiently strong condition that he will be able to go about and perform his ordinary duties. This is done by gradually increasing the amount of work he does, and thus raising a protective mechanism in the blood.

In order to get the foregoing essentials I used the following classification in my cases:-

Class A. Those cases which were febrile and who were placed at absolute rest.

Class B. Those cases in which there was no rise of temperature when allowed to sit up in bed.

Class C. Those cases allowed to remain up for two hours.

Class D./

Class D. Those cases allowed up for half a day, and who had half an hour's walk per day.

Class E. Cases allowed up all day with one hour's walk per day.

Class F. Cases up all day, one hour's walk and able to carry easy drill exercises.

Class G. Cases up all day, one hour's walk and able to perform full drill exercises.

The drill exercises for those in class F consisted of marching, arm, leg, and body exercises, and in breathing exercises to expand the chest.

In class G, in addition to these, skipping and more difficult limb and body exercises and gymnasium exercises were carried through.

All patients when admitted were placed in Class A, and if found non febrile were passed through the different stages until a rise of temperature was induced, in which case they were placed in the class previous to the one in which the temperature was raised. The rise in temperature must not be the only guide, but must be taken in conjunction with other constitutional symptoms, e.g., malaise, headache, etc., in these cases a temperature of 99 degrees is sufficient to show there has been an excessive auto-inoculation, and the amount of work should be diminished accordingly. In Class A complete immobilization is essential to reduce the temperature. The patient must not be allowed to do absolutely/

absolutely anything, until the temperature has been normal for 48 hours, after which time he may be placed in Class B, and so on, until he has gone through each class.

In addition to the graduated exercises all children in classes D. E. F. G. attended an open air school from one to three hours per day, according to the class.

The following time table was followed in which time was given for rest, school, and exercises:-

6.30 patients rise, bath and assist in ward work.

7.30 breakfast.

8 - 8.30 rest.

8.30 to 9.30 walking exercises.

9.30 to 10 rest.

10 to 12 School, and rest for those one hour at school.

12 to 12.45 dinner.

12.45 to 1.30 rest.

1.30 to 3.30 school, one hour graduated exercises for those in different classes.

3.30 to 4 tea.

4 to 4.30 rest.

4.30 to 5.30 recreation.

5.30 prayers.

6. Supper.

6.30 Bed.

The temperature was taken before rising at 6.30a.m.
at/

at 10a.m., half an hour after morning walk, at 4p.m., just before tea and after rest from graduated exercises. The evening temperature was taken at 6.30p.m., when all patients had gone to bed.

One of the secrets of success in carrying out the treatment of Pulmonary Tuberculosis is a strict adherence to routine. The more closely one day conforms to another and the more strict the routine of treatment is, the more beneficial and effective will the result be. Especially is this marked in active cases of the disease and in patients whose condition hovers on the borderland between activity and quiescence. Regularity in meals and in hours given over to exercise, rest, occupation, recreation and sleep, has a marked and beneficial effect upon the general health, chiefly indicated by a steady increase in weight.

In carrying out treatment by exercises it is important that during the "rest" periods the patient should be at absolute rest lying down, and it is advisable that all patients should be at rest for at least a quarter of an hour before each meal.

The aim in carrying out the treatment by exercise is to get the body into a good physical condition, and to educate the child how to breathe properly, and as to general deportment. In carrying out treatment by this method it is most important to take the temperature at regular intervals during the day, to note the presence/

presence of any unfavourable sign such as headache, loss of appetite, etc., and to weigh the child under exactly similar conditions at the same time each week.

The question of diet is an important one in any system of graduated exercise. Some of the most striking symptoms of the disease such as languor, general weakness, loss of weight and muscular wasting are directly due to loss of energy and loss of tissue. This loss of energy and tissue has therefore to be prevented or replaced by means of a suitable and generous diet.

Particular attention should be given in selecting foods, and in considering their value as a diet.

Milk is one of the articles of food highly recommended for the consumptive child. Its value lies in the percentage of both energy-producing and tissue forming elements which it contains. It should therefore be taken in considerable quantity by all children especially those who suffer from loss of strength and who are under their proper weight. As already stated, milk when taken in such quantity should always be boiled. Fresh meat should also form part of the diet and it should always be slightly undercooked; fat meat is of greater value than lean meat as it both produces energy and builds up the body. Bread and oatmeal porridge are also highly nutritious articles of food. We have thus in these the foundation of a perfect diet, and/

and to these may be added eggs and soups made from lentils and split peas. These are excellent for producing energy and size and weight of the body. The quantity of food will vary with the condition of the patient. A very large diet is not necessary, and the important points to adhere to are regularity at meals and a sufficient rest before and after taking food.

Table of diet recommended for consumptive children:-

Breakfast, 7.30 a.m.

- a. Oatmeal porridge followed by
- b. fish, sausages, boiled ham, bacon and eggs
or boiled egg.
- c. Bread and butter.
- d. Half pint milk (boiled) or weak tea or coffee
with plenty of milk in older children.

Lunch, 10a.m. Half pint milk and slice of bread and butter.

Dinner, 12 a.m.

- a. Soup, if meat course not provided.
- b. Fresh beef or mutton.
- c. Vegetables, potatoes and cabbage, cauliflower, turnips, etc.
- d. Steamed suet pudding with syrup, fruit
pudding or milk pudding.
- e. Half pint of milk.

Tea/

Tea, 3.30 p.m.

Slice of bread and butter and half pint of milk
or weak tea.

Supper 6p.m.

- a. Cold roast beef or mutton, tongue, rabbit, etc.
- b. Bread and butter.
- c. Half pint of milk.

It is important that the food should be served and taken hot by children, and it is advisable to use hot water plates for those patients sleeping in the open air. While this table is suitable for children able to take exercises it will have to be varied for advanced cases which require a light and more varied diet.

THE USE OF DRUGS IN TREATMENT.

Drugs are employed in the treatment of Pulmonary Tuberculosis with many objects.

1. With the object of attacking and preventing the growth of the Tubercle Bacillus or other organism with which the disease may be associated.
2. With the object of neutralizing poisonous toxins.
3. With the object of removing or relieving symptoms.

With regard to the first group, many drugs such as cinnamic acid, creosote, formic aldehyde, etc., have been used, but it is known that it is not possible by the administration of drugs by the mouth to obtain a sufficient concentration in the tissues to destroy living/

living bacteria, because the tissue cells succumb to most antiseptic drugs before the bacteria. It may be possible, however, to increase the activity of the tissues and thus help to destroy or to weaken the resistance of the bacteria, and to render their destruction by the tissue cells easier.

Drugs used in the second group are generally given with the object of reducing the temperature. These, except in certain unusual circumstances, are better avoided. Of the drugs mostly used Phenacetin may be relied upon to cause a depression in the high evening temperatures of the Tuberculous by a degree or more.

In group three, various drugs are used in the symptomatic treatment of the different conditions. Of these, perhaps the commonest are the dry, hacking, troublesome cough, night sweating, and haemoptysis.

Various drugs are in use in the treatment of cough and haemoptysis, the most important and useful being, of course, one of the morphine derivatives. Codeine being regarded as superior to morphine in the treatment of cough because it does not render the respiration more shallow like morphine, and because it does not produce the same degree of constipation

Of the drugs used in night sweating atropine is the one upon which it is always possible to rely. A 1/150 of a grain at bed time will depress the nerve endings to the glands to a degree sufficient to stop sweating.

Of/

Of remedies used for general or tonic purposes in the nature of foods, cod liver oil is the most useful and it has been shown that its administration increases not only the total absorption of fats, but also the percentage of all fats taken, and further that it increases the retention of nitrogen. It is clearly then a different kind of food from other fats, such as cream and butter, and when general metabolism is ^{ab-}normal it may supply a deficiency. Cod liver oil is undoubtedly the most valuable drug in the treatment of tuberculosis we have. None of the other drugs in use for symptomatic treatment have proved of superior benefit to that obtained from the complete immobilization of those cases in which rest is indicated and with the exception of Morphia are of little value.

TUBERCULIN IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

In a disease like tuberculosis with its varied manifestations, its acuteness and chronicity, it is no easy matter to estimate the real value of any specific system of treatment. Especially is this true in relation to tuberculosis of the lungs, when temporary improvement takes place often under different methods of treatment, but there are cases in which the results of tuberculin treatment are so rapid, striking/

striking, and apparently permanent that in all fairness in this its second advent should be recorded.

Some Tuberculin enthusiasts have of recent years sought to minimise the importance of Sanatorium treatment, and held out Tuberculin as almost a panacea for all Tuberculous diseases, a course which is again likely to place the remedy in a false position.

Sanatorium benefits either in the form of Sanatorium treatment or in the supervision of appropriate rest and exercise, fresh air, good feeding etc., and Tuberculin treatment must be regarded as interdependant if the best results are to be obtained.

In the administration of Tuberculin the cardinal principle to be observed is the "avoidance of reaction", and treatment must in all cases be started with small doses.

In the fatal period of infancy, after the Tuberculous process has gained a footing in the system Tuberculin treatment has an exceedingly limited range of utility. In cases in which by the periodic and regular application/^{of}the Von Pirquet's cutaneous test, the exact time of infection has been determined. The small dose method then holds out some prospect of affording artificial aid to the natural process.

In the administration of Tuberculin no definite dosage can be given, and each case must be treated on its own merits. The general condition of the subject, the/

the pulse, temperature and the local condition at the site of infection serve as guides to the future treatment.

In my wards I carried out the treatment by Tuberculin in all suitable cases in those cases having exercises in the different grades.

Some of the cases under my care had been resident in the hospital for some months, and in some cases, years without any special method of treatment. In all cases I started the treatment by graduated exercises and later used Tuberculin.

The conclusion I have come to in regard to special treatment with graduated exercises and Tuberculin will be shown in the following six typical cases, whom I have picked out to show their condition before starting graduated exercises, and the benefit gained from these, and further the improvement made in these cases when a course of Tuberculin was given. My conclusions may then be summarised as follows:-

1. Children admitted to a Sanatorium, with or without definite physical signs, improve for a short time on general improved conditions of fresh air, food, etc.
2. These children after a three or four months gradual improvement as to general condition remain stationary as regards weight and physical signs.
3. Without special treatment they are sensitive to auto/

auto-inoculation when started on a higher grade form of exercise, e.g., skipping or a sharp walk.

4. On graduated exercises, the general condition improves, the appetite better, and the weight increases.
5. They are able to do much heavier work after a time.
6. There is little if any improvement in the physical signs.
7. After the final stages of exercise has been attained, and the patients can remain in this stage, there is very little further gain in weight.
8. Patients on reaching the final stage of exercise when put on Tuberculin treatment begin to further gain in weight and more closely approach their normal weight.
9. The Physical signs in the lungs tend to improve.
10. Patients put on Tuberculin treatment, can more quickly reach the final grade of exercise, and more quickly gain in weight, their general condition improves and the physical signs tend to disappear.

The following epitome of six cases will show the improvement as shown chiefly by a gain in weight, when children had been on a course of graduated exercises, and also the further improvement made after
a/

a course of Tuberculin treatment. New Tuberculin T. R. was used.

Case I. H. C. Born January 17th, 1900; admitted Q.M.H. July 24th, 1909. Family history - mother died from phthisis.

Clinical Notes on Admission.

Lungs. Br. Sounds harsh; vocal resonance increased over upper left lung; expansion poor.

Weight. 3 st. 12 lbs.

Condition beginning 1910.

Lungs. Left apex as on admission with a few rales at anterior and posterior upper apex. Temperature has had occasional rises up to 100 degrees. Weight 4 st. 4lbs.

Condition June 1911, when the case came under my care.

Clinical notes. Teeth, several carious; slight enlargement of the cervical glands; throat and pharynx nil.

Lungs. Left apex anteriorly, diminished movement, flat, impaired resonance. Respiration harsh, expiration prolonged. Left axilla, dullness, air entry diminished, vocal resonance increased, some friction.

Left apex posteriorly, few rales supraspinous fossa. Left lower lobe, dull, air entry diminished, V.R. increased. Bronchophony, expiration prolonged, amphoric/

amphoric breathing in places, friction sounds and fine rales.

Heart apex beat 6th space ant. axillary line.

Temperature, frequent rises to 100 degrees. Von Pirquet reaction positive.

Cough and expectoration present. No Tubercle found. Weight 4st. $7\frac{1}{2}$ lbs.

Started on graduated exercises and proceeded with until November 1911, when top grade was reached after periodic delays due to rise of temperature from auto-inoculation.

Condition November 1911.

Lungs. Physical signs In statu quo.

Temperature steady.

General condition improved.

Weight 4st. $11\frac{1}{2}$ lbs.

Cough occasionally, no expectoration.

November 1911. Tuberculin treatment begun, and exercises continued as before. A full course of Tuberculin (T.R.) was given. The injections were given twice a week at first and once a week towards the end of the course.

During the whole course, from November 7th 1911 until May 4th 1912, there was only a rise of temperature never more than 99 degrees on nine occasions, and a local reaction at site of injection of seven occasions.

Condition May 1912.

Left/

Left lung anteriorly as in June.

Left apex posteriorly - few rales expiration prolonged.

Left lower lobe, dull vocal res. increased, air entry good. Br. Brg. few rales.

Temperature normal.

No cough or expectoration.

Weight 5 st. 5 lbs.

The variation in weight under the different forms of treatment was thus:-

With no special treatment, from July 1909 until June 1911 the gain in weight was from 3 st. 12 lbs. to 4 st. $7\frac{1}{2}$ lbs., equal to a gain of $9\frac{1}{2}$ lbs in practically two years, and of this a certain proportion is due to the increasing age of the child.

Under graduated exercises - June 1911 - Nov. 1911.

Weight June 1911 - 4 st. $7\frac{1}{2}$ lbs.

" Nov. 1911 - 4 st. $11\frac{1}{2}$ lbs.

an increase of weight of 4 lbs in five months.

At this stage the weight remains stationary until treatment with Tuberculin is commenced - Nov. 1911.

Weight Nov. 1911 - 4 st. $11\frac{1}{2}$ lbs.

" May 1912 - 5 st. 5 lbs. equal $7\frac{1}{2}$ lbs gain in six months, after Tuberculin treatment, and graduated exercises.

Case No. 2. L. N. Born August 10th 1899. Admitted April 7th 1911.

Family/

Family history. Mother died phthisis.

Clinical notes. May 1911, general condition pale and anaemic in appearance. Some adenoid growths present. The veins of neck and chest enlarged. Flatness above and below each clavicle, general nourishment poor.

Lungs right apex anteriorly, dulness, Br. Brg. rales, and increase of vocal resonance, and vocal fremitus. Right lung posteriorly, apex V.R. increased, Br. Brg. and rales persisting after coughing.

Left ant. apex, few rales, and a few rales posteriorly near spine.

Cough present - No expectoration.

Weight in May 1911. 5 st. Temperature steady.

Put on graduated exercises from May until September 1911. Temperature - frequent small rises after exercise.

Condition September 1911.

Lungs - same condition as in May.

Temperature steady. Weight 5 st. $11\frac{1}{2}$ lbs.

Cough and expectoration present. No T.B. found in sputum. There was thus a gain in weight of $11\frac{1}{2}$ lbs in five months. In October friction sounds were heard over the right base and the temperature became unsteady and T.B. were now found in the sputum. The weight decreased to 5 st. $7\frac{1}{2}$ lbs.

When the temperature became normal again graduated exercises/

exercises were further continued and Tuberculin treatment commenced in November 1911. The temperature remained normal throughout the whole course and the weight rapidly improved. Small doses of T. R. were given at first and later increased to the usual dosage given.

The course lasted until April 1912, and the condition at the time had very markedly improved.

The Lungs.

The left lung showed no definite physical signs.

Right lung, all the moist sounds disappeared.

Cough and expectoration were absent.

Weight was 6 st. $4\frac{1}{2}$ lbs.

The condition thus shows a marked improvement, and if the loss of weight due to the pleurisy in October be included the increase of weight under different forms of treatment will easily be seen.

Weight on admission 5st.

Weight after exercises 5st $11\frac{1}{2}$ lbs. equal gain $11\frac{1}{2}$ lbs.

Weight after exercises and T. R. 6st. $4\frac{1}{2}$ lbs. equal gain of 7lbs.

Case No. 3. R. W. Born Nov. 12th 1897, admitted October 13th 1909. History of Pulmonary Tuberculosis since 1906. Von Pirquet positive; family history good.

Clinical Note, show involvement of the right apex.

Weight/

Weight on admission 4st. 11lb. .

Weight Jan. 1910 4st. $4\frac{1}{2}$ lbs. equal gain $3\frac{1}{2}$ lbs in 3 months.

Weight June 1911 4st. 12lbs. equal gain $7\frac{1}{2}$ lbs in 18 months.

Graduated exercises begun in June 1911 and final stage was reached in Sept. 1911.

Weight in Sept. 1911 5st. $8\frac{1}{2}$ lbs. equal gain on exercises of $10\frac{1}{2}$ lbs in 4 months.

Weight now remains practically stationary.

Tuberculin commenced Oct. 1911, and continued until March 1912.

Weight in March 1912 6st. 6lbs. equal gain of $11\frac{1}{2}$ lbs in 5 months.

The physical signs in the lungs which though never very definite all disappeared. The cough which was originally present disappeared.

Case No. 4. E. M. Born February 1st, 1899, admitted July 21st 1911. Father died phthisis.

Condition of lungs on admission.

Left apex, deficient expansion, diminished resonance, crepitations on coughing, breathing harsh, and expiration prolonged, cough present, no expectoration, Von Pirquet positive, weight 4st. 7lbs.

Temperature steady.

Put on graduated exercises, final grade reached Nov. 1911. Temperature was periodically unsteady after exercises/

exercises, until the last grade was reached.

Weight Nov. 1911 4st. 12lbs. equal gain 5lbs.

Cough had now disappeared.

In Nov. Tuberculin was commenced, and continued until March 1912. The temperature occasionally showed a rise to 99 degrees, weight in this case did not show any marked improvement until near the end of the course.

Weight in Feby. 1912 equal 4st. $13\frac{1}{2}$ lbs.

Weight in March 1912 equal 5st. 3lbs. equal gain 5lbs.

During the course of Tuberculin the child developed a Vincent's Angina and this will probably partly account for the slowness of gain in weight at first.

The physical signs in the lungs completely disappeared.

Case No. 5. E. J. Born April 10th 1902, admitted December 13th 1910; condition in May 1911, Tuberculosis history in father's family. Teeth carious, nasal discharge, cervical glands enlarged, appetite very poor, easily exhausted, night sweats, cough present.

Weight, which was 3st. $8\frac{1}{2}$ lbs. on admission in December 1910 was now 3st. $6\frac{1}{2}$ lbs., showing a loss of 2lbs since admission.

Lungs. Upper lobe ant. flat, impaired note, V.R.increased, crepitations and harsh brg.

Posteriorly, crepitation heard both upper apices, air entry diminished, Von Pirquet positive reaction.

In/

In June graduated exercises commenced and continued until Sept. 1911. General condition improved. The temperature showed the usual variation, and the weight was now 3st. 9½lbs. Tuberculin was now given and continued until March 1912. The clinical signs in the lungs now disappeared, and the general condition had greatly improved. The weight was 3st. 12lbs. in March 1912.

This case though not showing such a marked gain in weight gained under treatment 5½lbs. and the weight which had decreased at first, and then became stationary, thus began to improve and the general condition shows the benefit of treatment by these special methods.

Case No. 6. L. G. Born December 15th 1910, admitted January 24th 1911. Family history, father died phthisis, previous illness scarlet fever, tonsils and adenoids.

Condition May 1911. Weight 3st. 9½lbs.

Lungs. Ant. apices, breathing harsh, expiration prolonged and rales. Post. apices, rales present, and at base of right lung a scar from previous operation from empyema, with rales heard all round the base. There was slight cough and expectoration. No T.B. found. Von Pirquet positive reaction, temperature normal. In this case I commenced Tuberculin treatment when the patient had reached grade E, one month after starting the exercises in May, the weight in June being 4st./

4st. $0\frac{1}{2}$ lb. Both the tuberculin and exercises were continued from June until November 1911, the weight rapidly increased especially towards the latter end of the course, and was now 4st. $9\frac{1}{2}$ lbs. There was thus a gain of weight of 1st. in eight months. All the physical signs disappeared except a few indefinite signs round the base in the region of the empyema scar.

SUMMARY AND CONCLUSIONS.

As regards incidence and infectivity.

Tuberculosis is the commonest of all diseases to which childhood is liable. Children are highly susceptible to the disease, and that although the congenital form of the disease is practically unknown. A Phthisical Diathesis is strongly hereditary and predisposes subsequently to the more easy development of Tuberculosis.

As regards diagnosis.

It is too late to wait for the development of definite physical signs before carrying out the most suitable treatment, and that more consideration should be given to the constitutional symptoms, the careful examination of the lymphatic system and to the evidence afforded by the specific tests.

As Regards Treatment.

Prophylactic.

The essential measure to be adopted in infancy when/

when the environment is known to be one of open infection is to remove the child from the source of danger.

In older children careful attention to the diseases such as measles, bronchitis, whooping cough, etc., the proper feeding of the child, adequate clothing, cleanliness and fresh air should be given, and their strength so maintained that any Tuberculous process that may be present will be kept under the control of the natural resources of defence.

Therapeutic Treatment.

Cod Liver Oil is the best drug to be taken as a food stuff. Tuberculin treatment is not suitable in all cases but is undoubtedly of great benefit in the treatment of those cases whose general condition has improved, and whose vitality has been raised by treatment from graduated exercises. In these cases it seems to act as a stimulant and the benefit it gives is mostly marked by an increase in weight and in some cases by improvement of the physical signs in the lungs.

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